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(54) Spiral base structures for long nip paper machine press belts

(57) A belt (16) for use on a long nip press (10) for dewatering a fibrous web (24) includes a base (40) assembled by spirally winding a prepared structure strip (34) in a plurality of non-overlapping turns. Successive turns are abutted against and joined to those previously wound by sewing or otherwise bonding along the continuous spiral seam 38 thus formed. The prepared structure strip (34) may be a fabric strip (34) of a single- or multi-layer weave, woven from lengthwise (48) and crosswise yarns (50), which may be monofilament yarns of a synthetic polymeric resin. At least one side of the base (40), the side which will be on the inside of the belt and which slides over the pressure shoe (14) is coated with a polymeric resin, such as polyurethane, to protect it from wear and render it impervious to oil and water. The coating (54) is ground and buffed to provide the belt (16) with a smooth surface and a uniform thickness.

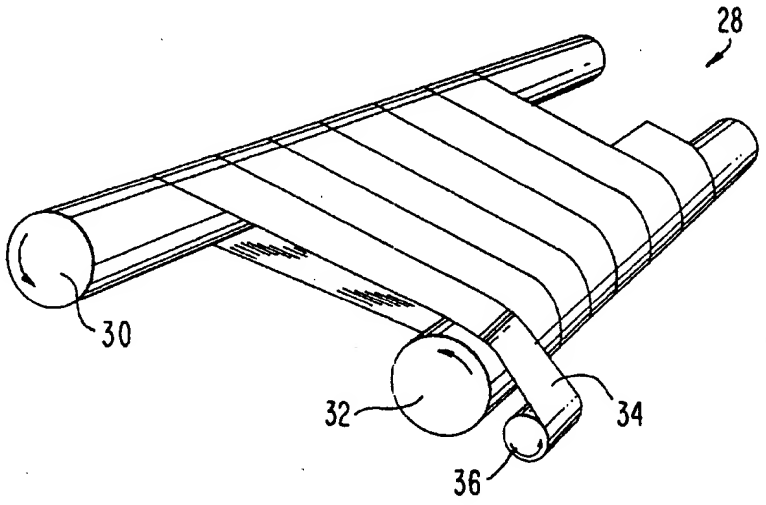

FIG. 3

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Description

The present invention relates to mechanisms for extracting water from a web of material, and more particularly from a fibrous web being processed into a paper product on a papermaking machine. Specifically, the present invention relates to an impermeable belt designed for use in conjunction with a long nip press on a papermaking machine, and to a method for making the impermeable belt.

During the papermaking process, a fibrous web is formed on a forming wire by depositing a fibrous slurry thereon. A large amount of water is drained from the slurry during this process, after which the newly formed web proceeds to a press section. The press section includes a series of press nips, in which the fibrous web is subjected to compressive forces designed to remove water therefrom. The web finally proceeds to a drying section which includes heated dryer drums around which the web is directed. The heated dryer drums reduce the water content of the web to a desirable level through evaporation.

Rising energy costs have made it increasingly desirable to remove as much water as possible from the web prior to its entering the dryer section. The dryer drums are often heated from within by steam and related costs can be substantial especially when a large amount of water needs to be removed from the web.

Traditionally, press sections have included a series of nips formed by pairs of adjacent cylindrical press rolls. In recent years, the use of long press nips has been found to be advantageous over the use of nips formed by pairs of adjacent press rolls. The longer the time a web can be subjected to pressure in the nip, the more water can be removed there, and, consequently, the less water will remain behind in the web for removal through evaporation in the dryer section.

The present invention relates to long nip presses of the shoe type. In this variety of long nip press, the nip is formed between a cylindrical press roll and an arcuate pressure shoe. The latter has a cylindrically concave surface having a radius of curvature close to that of the cylindrical press roll. When the roll and shoe are brought into close physical proximity to one another, a nip is formed which can be five to ten times longer in the machine direction than one formed between two press rolls. This increases the so-called dwell time of the fibrous web in the long nip while maintaining the same level of pressure per square inch in pressing force used in a two-roll press. The result of this new long nip technology has been a dramatic increase in dewatering of the fibrous web in the long nip when compared to conventional nips on paper machines.

A long nip press of the shoe type requires a special belt, such as that shown in US Patent No. 5,238,537. This belt is designed to protect the press fabric supporting, carrying and dewatering the fibrous web from the accelerated wear that would result from direct, sliding contact over the stationary pressure shoe. Such a belt must be provided with a smooth, impervious surface that rides, or slides, over the stationary shoe on a lubricating film of oil. The belt moves through the nip at roughly the same speed as the press fabric, thereby subjecting the press fabric to minimal amounts of rubbing against the surface of the belt.

Belts of the variety shown in US Patent No. 5,238,537 are made by impregnating a woven base fabric, which takes the form of an endless loop, with a synthetic polymeric resin. Preferably, the resin forms a coating of some predetermined thickness at least on the inner surface of the belt, so that the yarns from which the base fabric is woven may be protected from direct contact with the arcuate pressure shoe component of the long nip press. It is specifically this coating which must have a smooth, impervious surface to slide readily over the lubricated shoe and to prevent any of the lubricating oil from penetrating the structure of the belt to contaminate the press fabric, or fabrics, and fibrous web.

Long nip press belts, such as that shown in US Patent No. 5,238,537, depending on the size requirements of the long nip presses on which they are installed, have dimensions of length from 3 to 12m (10 to 40 feet), measured longitudinally around its endless-loop form, and of width from 2.5 to 11.4m (100 to 450 inches), measured transversely across. Whether its woven base fabric is flat-woven, and subsequently seamed into endless form, or is woven endless in tubular form, large weaving looms are required for their production. In either case, the weaving process is a time-consuming and cumbersome operation, as the woven base fabric must have the same dimensions as the finished long nip press belt.

The present invention provides a solution to this problem in the form of a spiral base fabric, which may comprise, for example, a plurality of spirally wound and joined turns of a relatively narrow woven fabric, which base fabric may be used as an endless base fabric for a long nip press belt.

The present invention relates to a belt for use on a long nip press of the shoe type for dewatering a fibrous web, said belt comprising:

a base comprising a spirally wound prepared structure strip, said strip having a width smaller than a width of said base, said base being a plurality of non-overlapping turns of said spirally wound prepared structure strip, said base thereby having the form of an endless loop with an inner surface, an outer surface, a longitudinal direction and a transverse direction; and

a coating of a polymeric resin on at least one of said inner and outer surfaces of said base, said coating impregnating and rendering said base impervious to liquids, said coating being smooth and providing said belt with a uniform thickness.

Accordingly, the present invention relates to a belt for use on a long nip press for dewatering a fibrous web, and a method for manufacturing the belt. The belt comprises a base assembled by spirally winding a prepared structure strip, for example, around two parallel rolls. The prepared structure strip may be a fabric strip woven from lengthwise and crosswise yarns and has a smaller width than the width of the base as a whole.

The base is a plurality of non-overlapping turns of the spirally wound prepared structure strip. Preferably, adjacent turns are abutted against one another and joined together by stitching or bonding. The base so produced has the form of an endless loop with an inner surface, an outer surface, a longitudinal direction, and a transverse direction.

Where the prepared structure strip is a woven fabric strip spirally wound to produce a woven base fabric, the lengthwise and crosswise yarns of the fabric strip do not align with the longitudinal and transverse directions of the woven base fabric, respectively, the latter being taken with reference to the endless loop form of the woven base fabric. Indeed the lengthwise yarns of the spirally wound fabric strip are inclined at an angle with respect to the longitudinal direction of the woven base fabric. The angle, typically small, is a measure of the pitch of the spiral winding.

In general, the lateral edges of the base, following assembly from the spirally wound prepared structure strip, require trimming to be made parallel to the longitudinal direction thereof.

A coating of a polymeric resin is provided at least on the inner surface of the base. The coating renders the base impervious to liquids, and is smooth and provides the belt with a uniform thickness. The coating impregnates the base, where the base is a fabric, and, in general, is preferably ground and buffed to provide the belt with a smooth surface and a uniform thickness.

The method for manufacturing the belt comprises the step of manufacturing a suitable prepared structure strip. Where the prepared structure strip is a woven fabric strip, it is woven from lengthwise and crosswise yarns in a preselected width. Preferably, the woven fabric strip is heat-set following its manufacture by weaving, and accumulated on a stock roll for later use.

The fabric strip is then wound, for example, around two parallel rolls, in a plurality of non-overlapping turns to assemble a woven base fabric. Each turn is preferably abutted against those adjacent thereto, and joined therewith by stitching or bonding. A woven base fabric, having an inner surface, an outer surface, a longitudinal direction and a transverse direction is the result. The lateral edges of the woven base fabric are then preferably trimmed, as discussed above, to render them parallel to the longitudinal direction of the woven base fabric.

Alternatively, the prepared structure strip may be a non-woven fabric strip, a perforated synthetic strip, or a polymeric film strip. By a non-woven fabric is meant a fibre structure produced by means other than weaving. Examples are spun-bonded fibre structures and fibre structures whose component fibres are bonded together at their crossover points by heat. Generally, these fibre structures are made from thermoplastic materials. The non-woven fabric may also be a needle-punched fibre structure.

The perforated synthetic strip may be a sheet of nylon extruded film or polyester film, either of which could be spirally wound and bonded. The strip can be perforated after extrusion in any of a number of patterns. Examples are round holes, square holes, chevron-shaped holes and diamond-shaped holes.

The polymeric film strip may be identical to the perforated synthetic strip except that it lacks perforations.

In each case, the prepared structure strip is spirally wound, and each turn of the spiral winding thereof preferably joined to those adjacent thereto by stitching or bonding in the manner described above to produce the base. The bonding methods may be mechanical in nature, for example, butt sewing or fibre entanglement. Such methods could be used where the prepared structure strip is either a woven or a non-woven fabric strip. Ultrasonic welding and heat fusion could be used with any of the varieties of prepared structure strip. Chemical bonding could also be used with any of the prepared structure strips.

At least one of the inner and outer surfaces of the base is then coated with a polymeric resin to cover the base and to form a layer of the polymeric resin on the chosen surface, providing the belt with a desired thickness.

The polymeric resin is then cured, and, preferably, ground and buffed to provide the belt with a smooth surface and a uniform thickness.

The present invention permits the use of a relatively narrow piece of prepared structure strip to create a large endless base by spiralling the narrow piece and, for example, by stitching or bonding the lateral edges of adjacent turns of the spiral together along the continuous spiral seam thus formed. A loom as narrow as 5cm (2 inches) could be used to produce a prepared structure strip in the form of a woven fabric strip, but, for reasons of practicality, a conventional textile loom having a width from 1.5 to 3m (60 to 120 inches) may be preferred.

In any event, it will be recognised that endless bases of a variety of widths and lengths may be provided by spirally winding a relatively narrow piece of prepared structure strip around two parallel rolls, the length of a particular endless base being determined by the separation between the two parallel rolls, and the width being determined by the number of spiral turns of the prepared structure strip. The current necessity of manufacturing complete bases of specified lengths and widths to order may thereby be avoided.

Various embodiments of the present invention will now be described, by way of example only, with reference being made to the figures, which are listed and

identified as follows:

Figure 1 is a side elevational view of a long press nip for which a belt according to the present invention is intended.

Figure 2 is a partially sectioned front view of the press nip shown in Figure 1.

Figure 3 is a perspective view of an apparatus used for assembling a woven base fabric of a belt according to the present invention.

Figure 4 is a top plan view of the same apparatus.

Figure 5 is a top plan view of the finished woven base fabric.

Figure 6 is a perspective view of the belt, as constructed in accordance with the present invention.

Figure 7 is a cross-sectional view of the belt taken as indicated by line 7-7 in Figure 6.

Figure 8 is a perspective view of an alternative belt embodying the present invention.

A long nip press for dewatering a fibrous web being processed into a paper product on a paper machine is shown in Figures 1 and 2. The press nip 10 is defined by a smooth cylindrical press roll 12, an arcuate pressure shoe 14, and a belt 16 according to the present invention arranged such that it bears against the surface of the cylindrical press roll 12. The arcuate pressure shoe 14 has about the same radius of curvature as the cylindrical press roll 12. The distance between the cylindrical press roll 12 and the arcuate pressure shoe 14 may be adjusted by means of conventional hydraulic or mechanical apparatus, which is not shown, connected to rod 18 pivotally secured to arcuate pressure shoe 14. The rod 18 may also be actuated to apply the desired pressure to the arcuate pressure shoe 14. It will be appreciated that the cylindrical press roll 12 and the arcuate pressure shoe 14 described above and shown in Figures 1 and 2 are conventional in the art.

A first papermaker's wet press fabric 20, a second papermaker's wet press fabric 22, and a fibrous web 24 being processed into a paper sheet are included in Figures 1 and 2. The motions of the belt 16, the first papermaker's wet press fabric 20, the second papermaker's wet press fabric 22, and the fibrous web 24 through the press nip 10 are upward in Figure 1. The belt 16 is disposed between the shoe 14 and press fabric 20 and thus has a shoe side and a felt side corresponding to the inner and outer surfaces, respectively. Lubricating means 26 in Figure 1 dispenses oil onto the side of belt 16 facing arcuate pressure shoe 14 to facilitate its sliding motion thereagainst.

Belt 10 includes a base comprising a plurality of non-overlapping turns of a spirally wound prepared structure strip. Figure 3 is a perspective view of an apparatus used for assembling the base. The apparatus 28 comprises a first roll 30 and a second roll 32, which are parallel to one another and which may be rotated in the directions indicated by the arrows. A prepared structure strip 34 is wound from a stock roll 36 and around first roll 30 and second roll 32 in a spiral. The stock roll 36 must be translated at a suitable rate along second roll 32 as the prepared structure strip 34 is being wound around the rolls 30,32.

A top plan view of the apparatus 28 is provided in Figure 4. The first roll 30 and the second roll 32 are separated by a distance D, which is determined with reference to the total length required for the belt 16 to be manufactured. Prepared structure strip 34, having a width W, is spirally wound onto the first and second rolls 30,32 in a plurality of non-overlapping turns from stock roll 36, which is translated along second roll 32 in the course of the winding. Successive turns of the prepared structure strip 34 are abutted against one another, and are joined to one another by stitching or bonding along spirally continuous seam 38 to produce a base 40 as shown in Figure 5. When a sufficient number of turns of the prepared structure strip 34 have been made to make a base 40 of desired width W, the spiral winding is concluded. The base 40 so obtained has an inner surface, an outer surface, a longitudinal direction, and a transverse direction. The lateral edges of the base 40 will initially not be parallel to the longitudinal direction thereof, and must be trimmed along lines 42 to provide the base 40 with the desired width W, and with two lateral edges parallel to the longitudinal direction of its endless-loop form (see Figure 4).

Prepared structure strip 34 may be a fabric strip woven from yarns (for example, monofilament yarns) of a synthetic polymeric resin, such as polyester or polyamide, in the same manner as other fabrics used in the papermaking industry are woven. After weaving, it may be heat-set in a conventional manner prior to interim storage on stock roll 36. Such a fabric strip may include lengthwise yarns and crosswise yarns, and may be of a single- or multi-layer weave. Because the fabric strip is spirally wound to assemble a woven base fabric, its lengthwise and crosswise yarns do not align with the longitudinal and transverse directions, respectively, of the woven base fabric. Rather, the lengthwise yarns make a slight angle, e, whose magnitude is a measure of the pitch of the spirally wound fabric strip, with respect to the longitudinal direction of the woven base fabric, as suggested by the top plan view of the base 40 shown in Figure 5.

Where the prepared structure strip 34 is a woven fabric strip, and, consequently, base 40 is a woven base fabric, the fabric strip is of a weave sufficiently open to permit complete impregnation thereof by the polymeric resin coating material. Complete impregnation eliminates the possibility of undesirable voids forming in the finished belt 16. Voids are particularly undesirable because they may allow the lubricating oil used between the belt 16 and the arcuate pressure shoe 14 to pass through the belt 16 and contaminate the press fabric 20, or press fabrics 20,22, and fibrous web 24 being proc-

essed into paper.

Alternatively, prepared structure strip 34 may be a non-woven fabric strip, a perforated synthetic strip, or a polymeric film strip.

A perspective view of belt 16 is provided in Figure 6. The belt has an inner surface 44 and an outer surface 46. On the outer surface 46, the base 40 and its spirally continuous seam 38 may be visible.

Figure 7 is a cross-section taken as indicated by line 7-7 in Figure 6 for the case where prepared structure strip 34 is a fabric strip. The cross-section is taken lengthwise with respect to the fabric strip. Fabric strip 34 is woven from lengthwise yarns 48 and crosswise yarns 50 in a multi-layer weave. Knuckles 52 appearing on the fabric strip 34 where lengthwise yarns 48 weave over cross wise yarns 50 may be visible on the outer surface 46 of the belt 16. The inner surface 44 of the belt 16 is formed by a polymeric resin coating 54.

The polymeric resin coating 54 is applied to at least one surface of the base 40, that surface being the one which will ultimately be the inner surface 44 of the belt 16. As the inner surface 44 slides across the lubricated arcuate pressure shoe 14, the polymeric resin coating 54 protects the base 40 from such sliding contact and the wear by abrasion that would otherwise result. The polymeric resin also impregnates the base 40 and renders the belt 16 impervious to oil and water. The polymeric resin coating 54 may be of polyurethane, and is preferably 100% solids composition thereof to avoid the formation of bubbles during the curing process through which the polymeric resin proceeds following its application onto the base 40. After curing, the polymeric resin coating 54 is ground and buffed to provide the belt 16 with a smooth surface and a uniform thickness.

In an alternative embodiment of the present invention, both surfaces of the woven base fabric 40 may be coated with a polymeric resin. Following the curing of the polymeric resin material, both the inner surface 56 and the outer surface 58 of belt 60, as shown in Figure 8, may be ground and buffed to provide the belt 60 with smooth surfaces and a uniform thickness. Finally, the outer surface 58 may be provided, by cutting, scoring or graving, with a plurality of grooves 62, for example, in the longitudinal direction around the belt 60, for the temporary storage of water pressed from fibrous web 24 in the press nip 10.

It will be recognised that modifications to the above would be obvious to anyone of ordinary skill in the art without departing from the claims appended hereinbelow.

Claims

1. A belt for use on a long nip press of the shoe type for dewatering a fibrous web, said belt comprising:

   a base comprising a spirally wound prepared structure strip, said strip having a width smaller than a width of said base, said base being a plurality of non-overlapping turns of said spirally wound prepared structure strip, said base thereby having the form of an endless loop with an inner surface, an outer surface, a longitudinal direction and a transverse direction; and

   a coating of a polymeric resin on at least one of said inner and outer surfaces of said base, said coating impregnating and rendering said base impervious to liquids, said coating being smooth and providing said belt with a uniform thickness.

2. A belt as claimed in claim 1 wherein said polymeric resin is polyurethane.

3. A belt as claimed in claim 1 or claim 2, wherein said prepared structure strip is a woven fabric strip, said strip being woven from lengthwise and crosswise yarns.

4. A belt as claimed in claim 3, wherein said fabric strip is a multi-layer fabric.

5. A belt as claimed in claim 3, wherein said fabric strip is a single-layer fabric.

6. A belt as claimed in any one of claims 3 to 5, wherein said lengthwise yarns and said crosswise yarns of said fabric strip are of a synthetic polymeric resin selected from the group consisting of polyester and polyamide resins.

7. A belt as claimed in claim 1 or claim 2, wherein said prepared structure strip is a non-woven fabric strip.

8. A belt as claimed in any one of claims 3 to 7, wherein said prepared structure strip is impregnated with said coating.

9. A belt as claimed in claim 1 or claim 2, wherein said prepared structure strip is a perforated synthetic strip.

10. A belt as claimed in claim 9, wherein said perforated synthetic strip is perforated with holes selected from the group consisting of round holes, square holes, chevron-shaped holes and diamond-shaped holes.

11. A belt as claimed in claim 1 or claim 2, wherein said prepared structure strip is a polymeric film strip.

12. A belt as claimed in any one of claims 1 to 11, wherein said base has two lateral edges, said two lateral edges being parallel to one another, aligned with said longitudinal direction of said base, and defining the width of said base.

13. A belt as claimed in any one of claims 1 to 12, wherein adjacent turns of said spirally wound prepared structure strip are abutted against one another.

14. A belt as claimed in claim 13, wherein said adjacent turns are joined to one another.

15. A belt as claimed in claim 14, wherein said adjacent turns are joined to one another by stitching.

16. A belt as claimed in claim 14, where said adjacent turns are joined to one another by fibre entanglement.

17. A belt as claimed in claim 14, wherein said adjacent turns are joined to one another by bonding.

18. A belt as claimed in claim 17, wherein said bonding is effected by ultrasonic welding.

19. A belt as claimed in claim 17, wherein said bonding is effected by heat fusion.

20. A belt as claimed in claim 17, wherein said bonding is effected by chemical bonding.

21. A belt as claimed in any one of claims 1 to 20, wherein said coating is provided on at least said inner surface of said base.

22. A belt as claimed in claim 21, further comprising a coating of a polymeric resin on said outer surface of said base, said coating being smooth and providing said belt with a uniform thickness.

23. A belt as claimed in claim 22, further comprising a plurality of grooves in said coating on said outer surface of said base.

24. A belt on a long nip press as claimed in claim 22 or claim 23, wherein said coating on said outer surface of said base is ground and buffed to give said belt a uniform thickness.

25. A belt as claimed in any one of claims 21 to 24, wherein said coating on said inner surface of said base is ground and buffed to give said belt a uniform thickness.

26. A belt on a long nip press for dewatering a fibrous web, said long nip press having a cylindrical press roll and an arcuate pressure shoe which together define a nip therebetween, said belt being passed through said nip in conjunction with at least one press fabric supporting and carrying said fibrous web to be dewatered between said press fabric and said arcuate pressure shoe, said belt comprising:

a base comprising a spirally wound prepared structure strip, said strip having a width smaller than a width of said base, said base being a plurality of non-overlapping turns of said spirally wound prepared structure strip, said base thereby having the form of an endless loop with an inner surface, an outer surface, a longitudinal direction and a transverse direction; and

a coating of a polymeric resin on at least said inner surface of said base, said coating impregnating and rendering said base impervious to liquids, said coating being smooth and providing said belt with a uniform thickness.

27. A method for manufacturing a belt for a long nip press for dewatering a fibrous web comprising the steps of:

(a) manufacturing a prepared structure strip having a preselected width;

(b) spirally winding said prepared structure strip in a plurality of non-overlapping turns to form a base of width greater than said preselected width of said prepared structure strip to provide a base in the form of an endless loop having an inner surface, an outer surface, a longitudinal direction and a transverse direction;

(c) coating at least one of said inner and outer surfaces of said base with a polymeric resin to cover said base and to form a layer of said polymeric resin thereon to provide said belt with a desired thickness; and

(d) curing said polymeric resin.

28. A method as claimed in claim 27, wherein the prepared structure strip is as defined in any one of claims 3 to 12.

29. A method as claimed in claim 27 or claim 28, wherein said polymeric resin is polyurethane.

30. A method as claimed in any one of claims 27 to 29, further comprising the step of manufacturing a fabric strip for use as said prepared structure strip and heat-setting said fabric strip.

31. A method as claimed in any one of claims 27 to 30, wherein the step of spirally winding said prepared structure strip is performed by spirally winding said prepared structure strip about at least two parallel rolls.

32. A method as claimed in claim 31, further comprising the step of abutting each turn of said prepared structure strip against that previously spirally wound during the step of spirally winding said prepared structure strip.

33. A method as claimed in claim 31 or claim 32 further comprising the step of joining each turn of said prepared structure strip to that previously spirally wound.

34. A method as claimed in claim 32, wherein the joining is as defined in any one of claims 16 to 21.

35. A method as claimed in any one of claims 27 to 34, further comprising the step of trimming said base to provide said base with lateral edges parallel to each other, aligned with said longitudinal direction of said base, and defining the width thereof.

36. A method as claimed in any one of claims 27 to 35, further comprising the step of grinding said cured polymeric resin to provide said belt with a smooth surface and a uniform thickness.

37. A method as claimed in any one of claims 27 to 36, wherein said inner surface of said base is coated with said polymeric resin material.

38. A method as claimed in claim 37, further comprising the step of coating said outer surface of said base with a second polymeric resin to form a layer of said second polymeric resin thereon to provide said belt with a desired thickness.

39. A method as claimed in claim 38, further comprising the step of curing said second polymeric resin.

40. A method as claimed in claim 39, further comprising the step of grinding said cured second polymeric resin to provide said belt with a smooth surface and a uniform thickness.

41. A method as claimed in claim 39 or claim 40, further comprising the step of providing a plurality of grooves in said cured second polymeric resin on said outer surface of said belt.

42. A method as claimed in any one of claims 38 to 41, wherein said second polymeric resin is polyurethane.

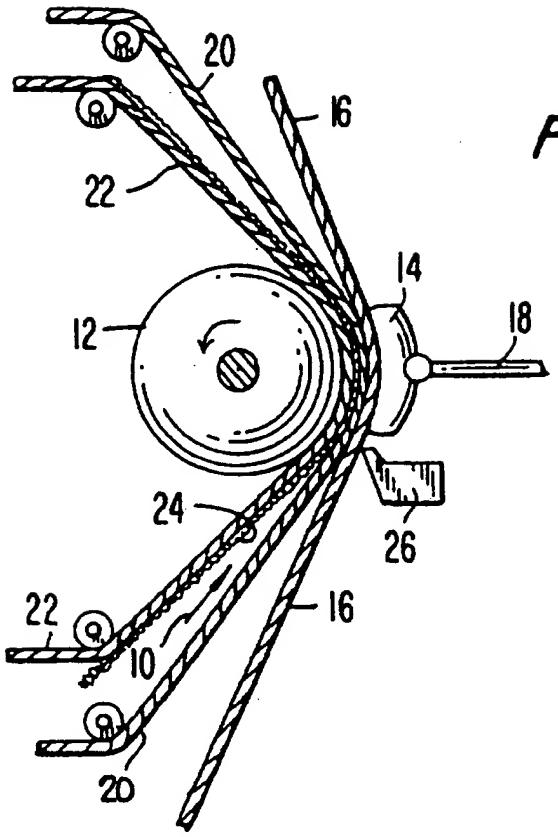

FIG. 1

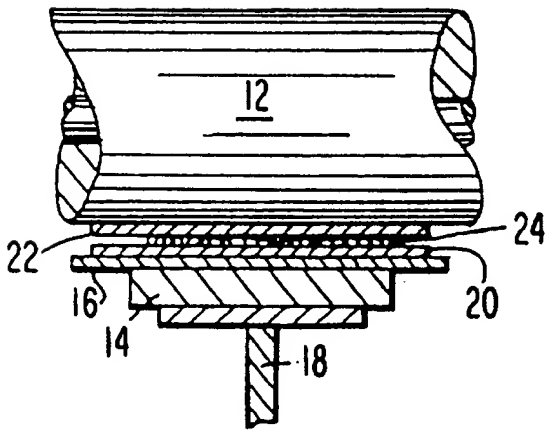

FIG. 2

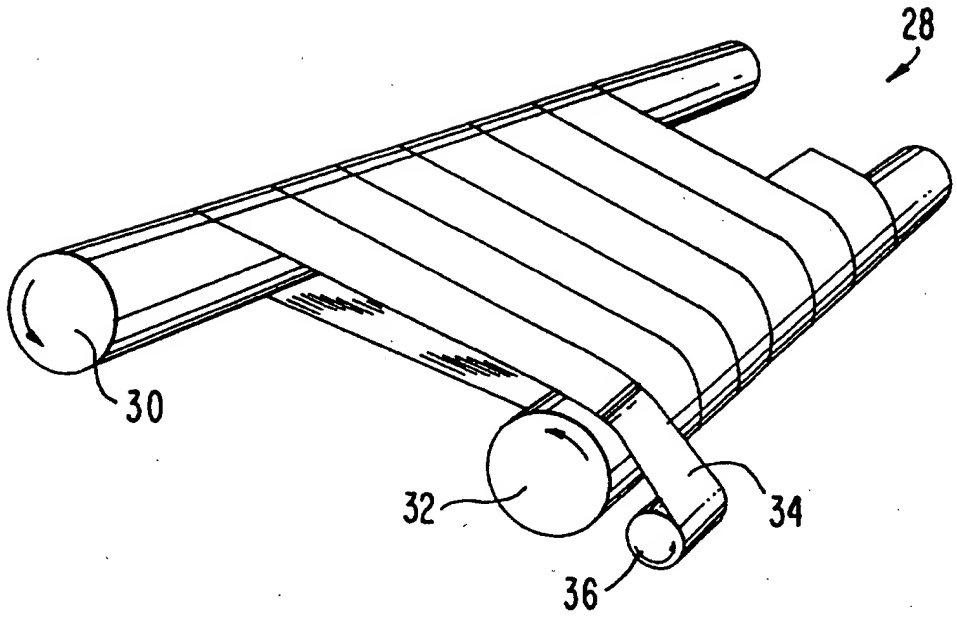

FIG. 3

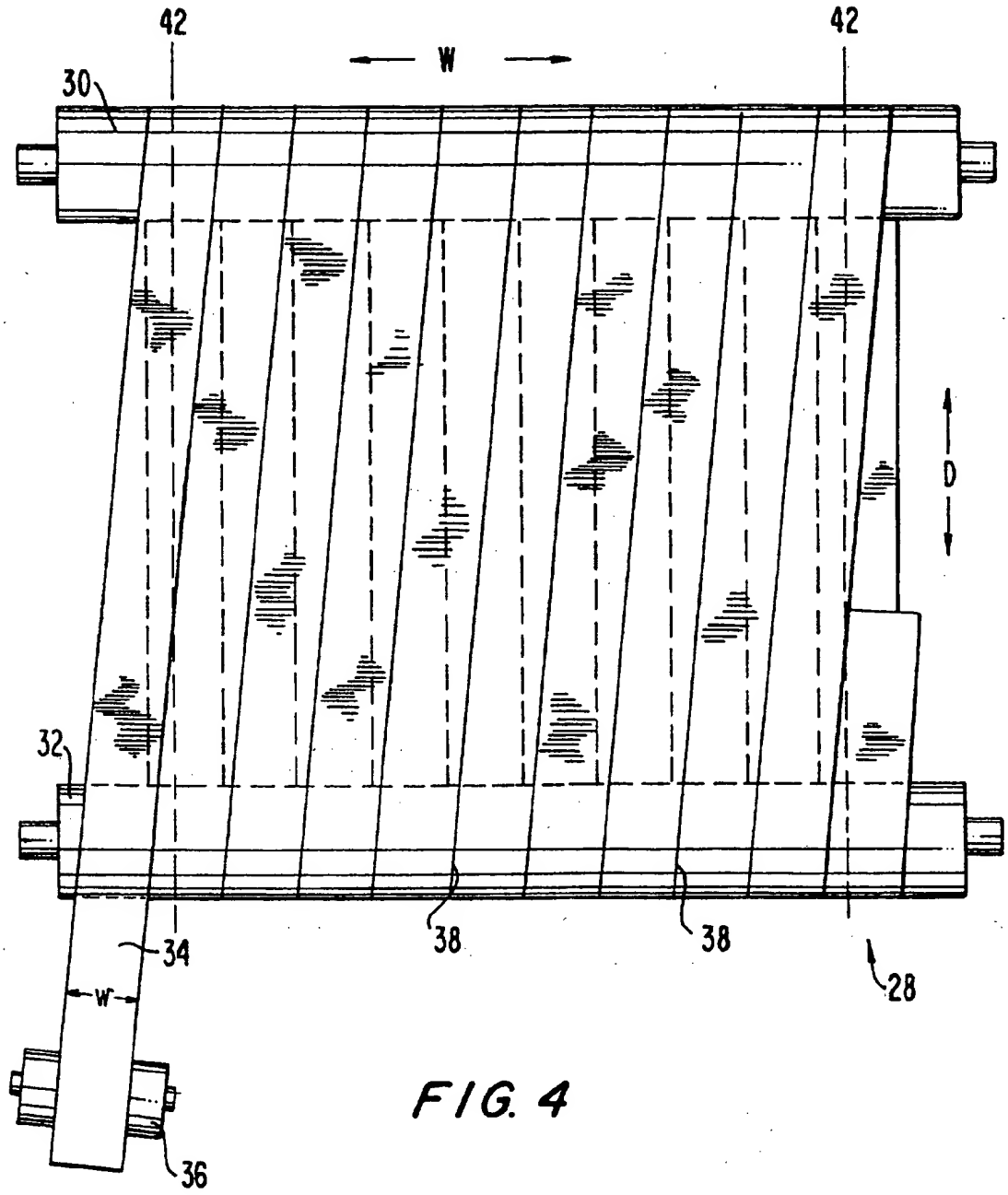

FIG. 4

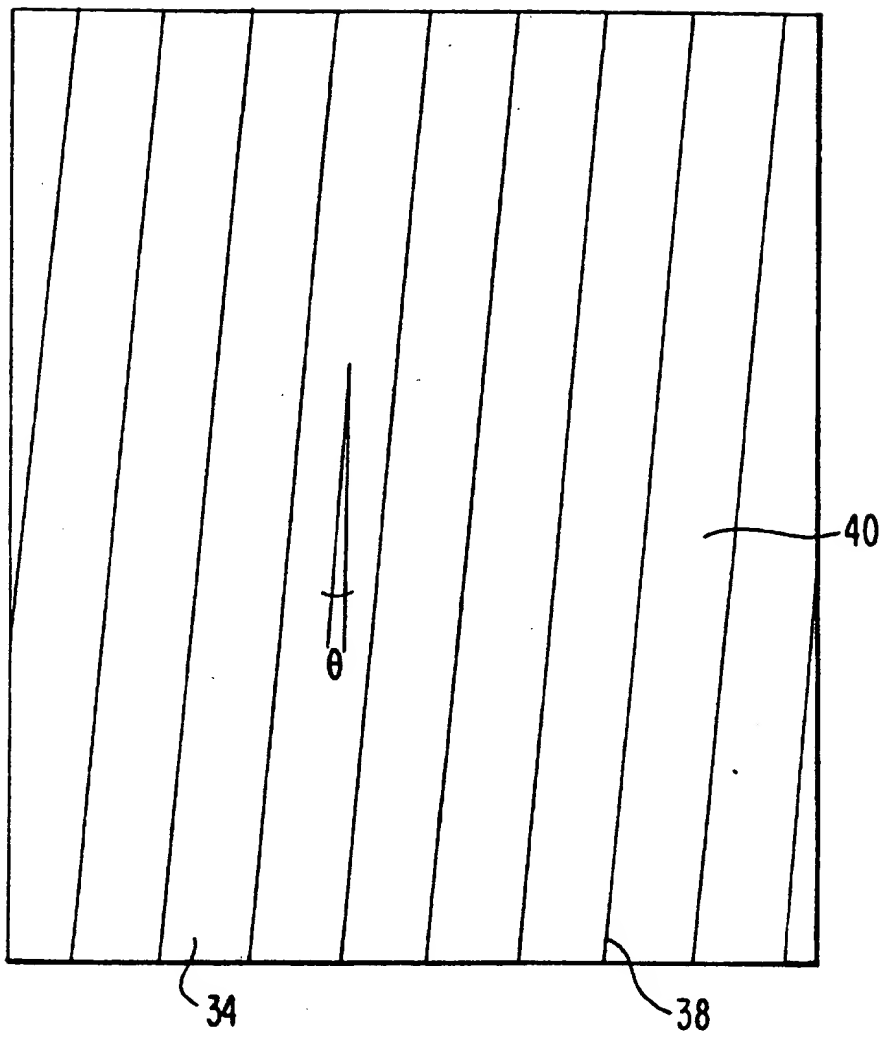

FIG. 5

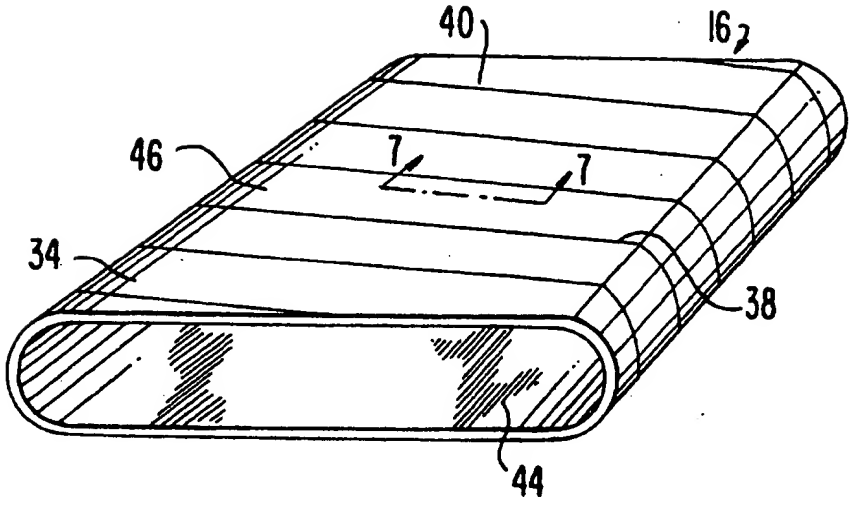

FIG. 6

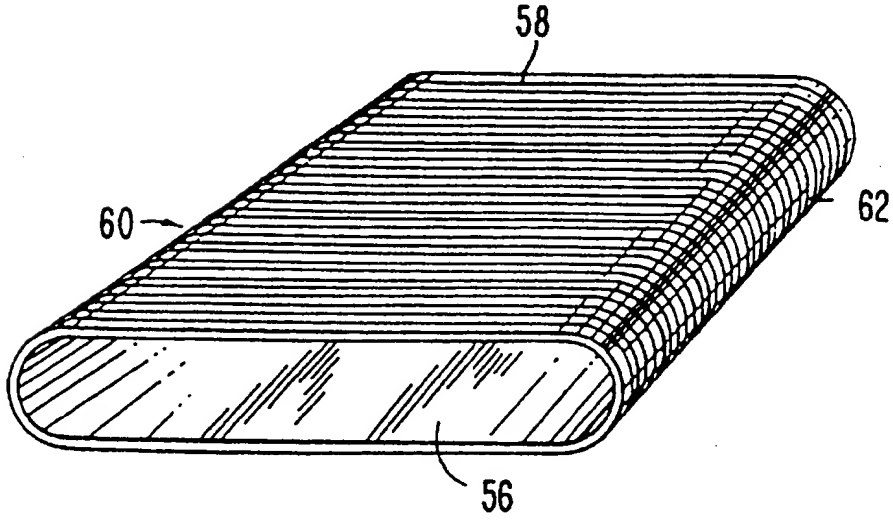

FIG. 8

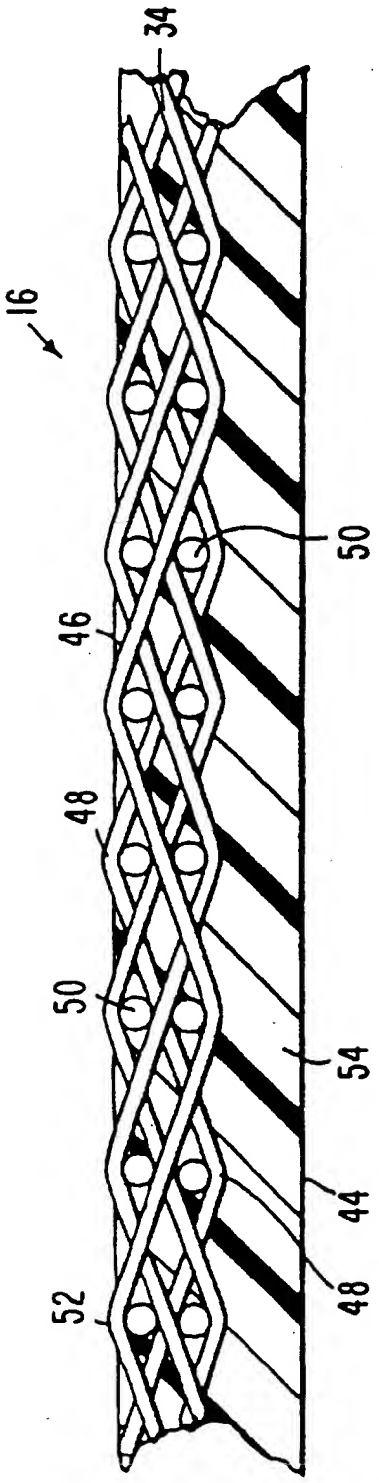

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 6358

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 538 211 (ALBANY INTERNATIONAL CORP.) * the whole document *	1-6,8, 12-14, 17,20, 23, 26-29, 31,35	D21F3/02
A	EP-A-0 665 329 (ALBANY INTERNATIONAL CORP.) * the whole document *	1,3, 12-15, 17-20, 26,27, 31-35	
A	EP-A-0 336 876 (BELOIT) * the whole document *	1,2,7,8, 12,26, 27,29, 31,35-42	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 December 1996	De Rijck, F

CATEGORY OF CITED DOCUMENTS

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D : document cited in the application
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